USE OF RADAR BACKSCATTER TO INFER AERODYNAMIC ROUGHNESS

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Aeolian transport of small p articles depe1 ds on w ind flow and i s an important quantity to n rea sure for several econom ic-1 elat ed re asons. If some estimate of wind regime could be made from rel notely-sensed data, important g eolog ical and ecolog ic al problems on Earth and other plan ets could be addressed.

The effect of roughness on the wind field i s parameter ized in te rms of the aerodynamic roughness z_0, a scaling length that, for a given surface, m easur es the height at which the wind speed should becomes zero due to the effect of surface topography. Microwave re flectivity is a function of the radar param eters used and the surfa ce proper ies (surface slope and rough n ess, and complex dielectric con stant). For modest topog raphy and typical materials, the rough n ess a t or ne ar the radar wavelength dominates. Since both radar and wind flow respond di rectly to surface roughness, it i s reasonable to suspect that a fairly well-beh aved quantitative relationship might e xist between normalized rada r backscatte r coefficient, σ^0, and z_0. 'I'11('1(' are,however, also re asor is 1 0 suspect that such a relationship might be limited. The Radar and Aeol ian Roughness Project (1< Al<l') hasbeen formed in order 1 0 investigate whether such a relationship exists, 1 0 determine the relationship(s) over a variety of surface types, and to seek a theoretical basis from which to extend the relationship to surfaces that cannot be directly examined. We have collected wind data using towers instrumented with anel nometers in both d esert and veg etat ed ar ea s, and have overflown these same sites w ith SIR- C/X-SAR and other SAR sensors. Multiple overflights o f each site created a data set from which σ^0 can b e calculated at mul ti ple incidence angles, frequencies ar id polarizations. D esert sites were chosen 0 1 1 lava flows, alluvial fans dominated by S a n d and gravel o f differing ages and roughnesses, and 0 1 1 a silt-clay playa. One vegetated s i l t in Denmark includes a variety o f tree and crop typ es (barely, rape, beet, peas and grasses and a stand of Spruce l l (' (' S) . Surface roughness height varies from centimeters to several n eters, and the corresponding roughness lengths are z_0 = 0.()()1 to 0.75.

The re sultant relationship o f σ^0 1 0 z_0 s n o w s that, for seven of the vegetated areas (t he agricultural fields), the relationships previously established for unvegetated silt.s is continued, although all o f the vegetated sites are both brighter in backscatter and roughe r tha n the previ ous studies. Measured in terms o f Coefficient of Fit, the best over all correlation i s at L-band (R^2 = 0.81).

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